

## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11- 155836

(43)Date of publication of application : 15.06.1999

(51)Int.Cl.

**A6B 5/11****A63B 23/035****A63K 3/00**

(21)Application number : 10- 063717

(71)Applicant : MATSUSHITA ELECTRIC WORKS LTD

(22)Date of filing : 13.03.1998

(72)Inventor : MURAKAMI SOJI  
SEKINE OSAMU  
SHINOMIYA YUICHI  
YOSHIDA YUKIO  
NOMURA JUNJI

(30)Priority

Priority number : 09260705 Priority date : 25.09.1997 Priority country : JP

(54) MOVEMENT ANALYZING METHOD AND MOVEMENT AUXILIARY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain stimulation suitable for preventing lumbago and improving a balancing function by providing forcible swinging for the tensing/slackening of a muscle group mainly in a waist part to a seat, measuring three-dimensional position information in the vicinity of the waist and the tensing/slackening state of the muscle group mainly in the waist and corresponding these to each other.

SOLUTION: A controller 3 is constructed by using a computer device, and controls a parallel mechanism 2 based on control information written beforehand from a data input section in a data storage section. For the data input section, a three-dimensional sensor attached to the vicinity of a human coccyx part, a motion capture composed of a plurality of TV cameras for detecting a position by picking up the image of the sphere of reflection attached to the vicinity of the human waist or the like is used. For performing this measuring, measuring time is adjusted beforehand for a surface muscle potential and three-dimensional position information. In other words, based on correspondence by time, the tensing/slackening of a muscle caused by any changes in a waist position is known.



\* NOTICES \*

**JP and INPIT are not responsible for any damages caused by the use of this translation.**

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

---

## CLAIMS

---

[Claim(s)]

[Claim 1] Movement analytical method giving compulsory rocking to a seat so that a muscle group which makes the lumbar part a subject in the state where it sat down on a seat may become tense and loosen, measuring a state of stress and relaxation of a muscle group which carries out three-dimensional position information and the lumbar part near the lumbar part with a subject, and matching both.

[Claim 2] At the same time it starts Measurement Division of three-dimensional position information near the lumbar part using motion capture which has arranged two or more sets of TV cameras, while a seat is the saddle attached to a horse and attaching a sphere of reflection near the lumbar part, The movement analytical method according to claim 1 starting Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis.

[Claim 3] At the same time a seat is a seat of a simulator which imitates a motion on a saddle and it starts Measurement Division of three-dimensional position information near the lumbar part using a magnetism measuring device, The movement analytical method according to claim 1 starting Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis.

[Claim 4] Movement analytical method extracting information about three-dimensional impaction efficiency near [ suitable for training of a muscle group relevant to prevention of low back pain ] the lumbar part from a measuring result of Claim 1 thru/or Claim 3.

[Claim 5] Movement analytical method extracting information about three-dimensional impaction efficiency near [ suitable for training of a muscle group relevant to balance maintenance ] the lumbar part from a measuring result of Claim 1 thru/or Claim 3.

[Claim 6] A seat where a trainee sits down, and a driving means which makes a seat rock by a three dimension, A movement auxiliary device, wherein it has a control means which directs a position of a seat to a driving means and a position of a seat in each time is determined using information about three-dimensional impaction efficiency near [ suitable for prevention of low back pain extracted with Claim 4 or movement analytical method of Claim 5 ] the lumbar part.

[Claim 7] It has a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [ which has the periodicity extracted corresponding to quick time and gallop of a horse, respectively ] the lumbar part, The movement auxiliary device according to claim 6, wherein a control means gives a unit pattern repeatedly read from a data storage means to a driving means.

[Claim 8] It has a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three-dimensional impaction efficiency near [ which has the periodicity extracted corresponding to a footpace of a horse ] the lumbar part, The movement auxiliary device according to claim 6, wherein a control means superimposes a change pattern accompanied by a sudden change on a unit pattern repeatedly read from a data storage means to irregular timing and gives it to a driving means.

[Claim 9] Claim 6, wherein a driving means is constituted by 3 flexibility so that a seat may be made to rock about a sliding direction, a roll, and a pitch thru/or the movement auxiliary device according to claim 8.

[Claim 10] A movement auxiliary device comprising:  
A seat where a trainee sits down.

A driving means which makes a seat rock by a three dimension.

A control means which directs a position of a seat to a driving means.

An electrical- parameter- extraction means to perform orthogonal transformation to a unit pattern of a position of a seat for which it asked from information about three- dimensional impaction efficiency near [ which has the periodicity extracted with Claim 4 or movement analytical method of Claim 5 ] the lumbar part, and to ask for a coefficient group as a parameter, A calculating means given to a control means in quest of position data which consists of two or more elements which show a position of a seat of each time using a parameter stored in a data storage means which memorizes a parameter, and a parameter storage means.

[Claim 11]The movement auxiliary device according to claim 10, wherein said calculating means adds a variation value of a random number to each element of position data and gives it to a control means.

[Claim 12]The movement auxiliary device according to claim 10, wherein said calculating means adds a variation value which has  $1/f$  fluctuation in each element of position data and gives it to a control means.

[Claim 13]The movement auxiliary device according to claim 10, wherein said calculating means carries out the multiplication of the coefficient to at least 1 element of position data and gives it to a control means.

[Claim 14]The movement auxiliary device according to claim 10 making variable a time interval which gives position data to a control means from said calculating means.

---

[Translation done.]

\* NOTICES \*

**JP and INPIT are not responsible for any damages caused by the use of this translation.**

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.\*\*\*\* shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

---

DETAILED DESCRIPTION

---

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the movement auxiliary device which can make prevention of the movement analytical method for creation of data required for prevention of low back pain, or training of a balance function, and low back pain, and movement for training of a balance function perform to a trainee.

[0002]

[Description of the Prior Art]Give a stimulus (generally vibration and rocking) to a trainee, it is made to exercise compulsorily conventionally, and the movement auxiliary device which acquired the specific movement effect is proposed [ various ]. There are some which were indicated to JP,H7- 67924,A as this kind especially proposed for relaxation of low back pain, or prevention of a movement auxiliary device. The movement auxiliary device indicated in this gazette becomes tense and is made to loosen the muscle group which makes the lumbar part a subject, when people have a saddle (seat) which straddles and sits down and do reciprocation moving of the saddle to order.

[0003]

[Problem(s) to be Solved by the Invention]As mentioned above, although there is a certain amount of [ that to which back and forth movement of the seat is carried out simply ] effect to relaxation and prevention of low back pain, it is not enough, and the high movement auxiliary device of the effect is demanded further. In view of the above- mentioned reason, succeed in this invention, and the purpose, It is in providing the movement analytical method which enabled it to ask for a stimulus suitable for prevention of low back pain, or improvement in a balance function, and providing the movement auxiliary device which trains the muscle group which makes the lumbar part a subject, and aims at prevention of low back pain, and improvement in a balance function.

[0004]

[Means for Solving the Problem]An invention of Claim 1 gives compulsory rocking to a seat so that a muscle group which makes the lumbar part a subject in the state where it sat down on a seat may become tense and loosen, it measures a state of stress and relaxation of a muscle group which carries out three- dimensional position information and the lumbar part near the lumbar part with a subject, and matches both. According to this method, in order to strengthen a muscle group which matches activity of a muscle group which carries out a position change and the lumbar part near the lumbar part with a subject, and is useful for prevention of low back pain, or strengthening of a balance function, it is easily analyzable what kind of position change should be given to the lumbar part. A term of a three- dimensional position is used in a meaning including parallel translation and a rotation. That is, right and left, and displacement and inclination of the upper and lower sides are included approximately.

[0005]An invention of Claim 2 is the saddle which a seat attached to a horse in an invention of Claim 1, Measurement Division of surface myoelectric potential of spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis is started at the same time it starts Measurement Division of three- dimensional position information near the lumbar part using motion capture which has arranged two or more sets of TV cameras, while attaching a sphere of reflection near the lumbar part. Since motion capture is used in this method, following in footsteps of a motion [ a actual horse ] is possible.

[0006]An invention of Claim 3 is a seat of a simulator by which a seat imitates a motion on a

saddle in an invention of Claim 1, Measurement Division of surface myoelectric potential of spine standing- up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis is started at the same time it starts Measurement Division of three- dimensional position information near the lumbar part using a magnetism measuring device. In this method, it becomes possible to create data indoors, without actually using a horse.

[0007]An invention of Claim 4 extracts information about three- dimensional impaction efficiency near [ suitable for training of a muscle group relevant to prevention of low back pain ] the lumbar part from a measuring result of Claim 1 thru/or Claim 3. An invention of Claim 5 extracts information about three- dimensional impaction efficiency near [ suitable for training of a muscle group relevant to balance maintenance ] the lumbar part from a measuring result of Claim 1 thru/or Claim 3.

[0008]An invention of Claim 4 and Claim 5 is a desirable embodiment. A driving means which an invention of Claim 6 makes rock a seat where a trainee sits down, and a seat by a three dimension, It has a control means which directs a position of a seat to a driving means, and a position of a seat in each time is determined by information about three- dimensional impaction efficiency near [ suitable for prevention of low back pain extracted with Claim 4 or movement analytical method of Claim 5 ] the lumbar part. According to this composition, a trainee only sits down on a seat, it can strengthen a muscle group which makes the lumbar part a subject, without doing one's best especially in muscular strengthening, and can perform prevention of low back pain, and strengthening of a balance function.

[0009]An invention of Claim 7 is provided with a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three- dimensional impaction efficiency near [ which has the periodicity extracted corresponding to quick time and gallop of a horse, respectively in an invention of Claim 6 ] the lumbar part, A control means gives a unit pattern repeatedly read from a data storage means to a driving means.

[0010]An invention of Claim 8 is provided with a data storage means which stores a unit pattern of a position of a seat for which it asked from information about three- dimensional impaction efficiency near [ which has the periodicity extracted corresponding to a footpace of a horse in an invention of Claim 6 ] the lumbar part, A control means superimposes a change pattern accompanied by a sudden change on a unit pattern repeatedly read from a data storage means to irregular timing, and gives it to a driving means.

[0011]An invention of Claim 7 and Claim 8 is a desirable embodiment, especially an invention of Claim 7 has an effect in prevention of low back pain, and an invention of Claim 8 has an effect in strengthening of a balance function. In an invention of Claim 6 thru/or Claim 8, an invention of Claim 9 is constituted by 3 flexibility so that a driving means may make a seat rock about a sliding direction, a roll, and a pitch. While according to this composition the same effect as a case where a driving means of 6 flexibility is used can be realized by a driving means of 3 flexibility and generation of a unit pattern becomes easy, cost can be reduced also about a mechanism.

[0012]A driving means which an invention of Claim 10 makes rock a seat where a trainee sits down, and a seat by a three dimension, A control means which directs a position of a seat to a driving means, An electrical- parameter- extraction means to perform orthogonal transformation to a unit pattern of a position of a seat for which it asked from information about three- dimensional impaction efficiency near [ which has the periodicity extracted with Claim 4 or movement analytical method of Claim 5 ] the lumbar part, and to ask for a coefficient group as a parameter, It has a calculating means given to a control means in quest of position data which consists of two or more elements which show a position of a seat of each time using a parameter stored in a data storage means which memorizes a parameter, and a parameter storage means. According to this composition, since what is necessary is just to store a parameter with little data volume in a data storage means as compared with a unit pattern in addition to the same operation as an invention of Claim 6, data volume stored in a data storage means can be reduced.

[0013]In an invention of Claim 10, said calculating means adds a variation value of a random number to each element of position data, and gives an invention of Claim 11 to a control means. In this composition, since a random number is added to position data, if amplitude of a random number added to position data is small set up as compared with amplitude of a time series of position data, Not to mention stopping being a periodic and monotonous motion and an effect of prevention of low back pain or relaxation being acquired, though a motion of a seat reflects

position data, It can prevent weariness arising or coming to maintain balance, without a habituation using muscles of the lumbar part, and a high effect can be acquired to strengthening of a muscle group which makes the lumbar part a subject.

[0014]In an invention of Claim 10, said calculating means adds a variation value which has  $1/f$  fluctuation in each element of position data, and gives an invention of Claim 12 to a control means. According to this composition, since  $1/f$  fluctuation is contained in rocking of a seat, in addition to the same operation as an invention of Claim 11, natural fluctuation which is not a mechanical and unnatural motion will be included in rocking of a seat.

[0015]In an invention of Claim 10, said calculating means carries out the multiplication of the coefficient to at least 1 element of position data, and gives an invention of Claim 13 to a control means. According to this composition, since amplitude which a seat rocks by setting up a coefficient suitably can be changed in addition to the same operation as an invention of Claim 6, according to a user's degree of acquisition and a habituation, strength of rocking is changeable.

[0016]An invention of Claim 14 makes variable a time interval which gives position data to a control means from said calculating means in an invention of Claim 10. According to this composition, by changing a time interval which gives position data to a control means in addition to the same operation as an invention of Claim 6, a repeating cycle of rocking of a seat can change and change can be given to speed which a seat rocks.

[0017]

[Embodiment of the Invention] (Embodiment 1) This embodiment moves the seat 1 where a trainee takes a seat according to the parallel mechanism 2 as a driving means, as shown in drawing 1. Motion control of the parallel mechanism 2 is performed by the control device 3 including the control means mentioned later.

[0018]The parallel mechanism 2 is provided with the following.

Standing ways 21 fixed to the regular position as shown in drawing 2

The movable base 22 supported above the standing ways 21 via the six legs 23.

Each leg 23 is combined via the universal joints 24a and 24b to the standing ways 21 and the movable base 22, respectively. The support pipe 23a which combined each leg 23 with the standing ways 21 via the universal joint 24a, It consists of the rod 23b which consists of a ball screw inserted into the support pipe 23a enabling a free attitude, and the actuator 23c which is provided with the gear which meshes to the rod 23b, and makes the rod 23b move with rotation of right reverse. The tip part of the rod 23b is combined with the movable base 22 via the universal joint 24b. Therefore, if the actuator 23c of each leg 23 is controlled, respectively and the amount of attitudes of the rod 23b is adjusted, the position of the movable base 22 to the standing ways 21 can be adjusted suitably.

[0019]The six legs 23 detach leg 23 comrades which are combined with the standing ways 21 as approached at a time in two, and are combined by approaching to the standing ways 21, and have combined them with the movable base 22. By such composition, control of 6 flexibility of the parallel translation of three directions which intersect perpendicularly mutually, and a rotation centering on an all directions-oriented axis is attained. That is, movement which combined right and left, up- and- down rectilinear- propagation reciprocation moving, and the rotation reciprocation moving around an antero- posterior axis, a lateral axis, and a normal axis is attained approximately, and the movable base 22 moves with 6 flexibility at the seat 1 combined with the movable base 22 as a result. The movable base 22 of the parallel mechanism 2 will perform those compounded operations rather than the operation decomposed into above rectilinear- propagation movements and rotations actually.

[0020]In order to give the following explanation easy, the coordinate system centering on the seat 1 is introduced. That is, an X axial direction and a longitudinal direction are made into Y shaft orientations, a sliding direction is made into Z shaft orientations for the cross direction of the seat 1, and the rectangular coordinate system of a right- hand system which sets the starting point as the center of the standing ways 21 of the parallel mechanism 2 is set up. A deer is carried out, and while the position of the three directions of an X axial direction, Y shaft orientations, and Z shaft orientations is variable, as for the movable base 22 of the parallel mechanism 2, inclination of the circumference of each axis of the X- axis, a Y- axis, and the Z- axis becomes variable. Rotation of the circumference of a pitch and the Z- axis is called [ rotation of the circumference of the X- axis ] a yaw for rotation of the circumference of a roll and a Y- axis.

[0021]The control device 3 is constituted using computer paraphernalia, and controls the parallel mechanism 2 based on the control information (position information) beforehand written in the data storage part (data storage means) 32 from the data input part 31 to be shown in drawing 3. As the data input part 31, the three- dimensional sensors (a magnetic measuring instrument, a gyro sensor, etc.) attached near people's coccyx are used, or the motion capture etc. which consist of two or more sets of the TV cameras which picturize the sphere of reflection (spherical reflecting object) attached near people's lumbar part, and detect a position are used. Generation of control information is mentioned later.

[0022]The data storage part 32 consists of semiconductor memory, and the control information stored in the data storage part 32 is changed into the length of each leg 23 of the parallel mechanism 2 in the operation part 30 (such a conversion operation is called inverse kinematics calculation). The result of an operation in the operation part 30 is given to the actuator control parts 33. In the actuator control parts 33, the operation amount of the actuator 23c according to the length of each leg 23 for which it asked by the operation part 30 is decided, and the actuator 23c is driven via the actuator 34. The actuator 34 controls the energization to the actuator 23c based on the operation amount decided by the actuator control parts 33. That is, a control means is constituted by the operation part 30, the actuator control parts 33, and the actuator 34 in this embodiment.

[0023]By the way, the control information stored in the data storage part 32, As shown in Table 1, about the seat 1 Position  $X_i$  of an X axial direction, Y shaft orientations, and Z shaft orientations,  $Y_i$ , and  $Z_i$  (i is a positive number), 6 groups with inclination (roll, pitch, yaw)  $\theta_{xi}$  of the circumference of the X- axis, the circumference of a Y- axis, and the circumference of the Z- axis,  $\theta_{yi}$ , and  $\theta_{zi}$  (i is a positive number) are set up with a certain time interval. This control information is the time series data generated as mentioned later, and one cycle is stored as a series of vibration patterns with periodicity. Below, such a series of vibration patterns are called unit pattern. This unit pattern is divided with a certain time interval shorter enough than one cycle, and the above- mentioned 6 groups are set up for every pause. In short, the unit pattern is constituted by the time series data of 6 groups.

[0024]

[Table 1]

時刻	X	Y	Z	ロール	ピッチ	ヨー
$T_1$	$X_1$	$Y_1$	$Z_1$	$\theta_{x1}$	$\theta_{y1}$	$\theta_{z1}$
$T_2$	$X_2$	$Y_2$	$Z_2$	$\theta_{x2}$	$\theta_{y2}$	$\theta_{z2}$
$T_3$	$X_3$	$Y_3$	$Z_3$	$\theta_{x3}$	$\theta_{y3}$	$\theta_{z3}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$T_r$	$X_r$	$Y_r$	$Z_r$	$\theta_{xr}$	$\theta_{yr}$	$\theta_{zr}$

[0025]Based on control information (unit pattern) as shown in Table 1, if inverse kinematics calculation is performed to the data of each time of Table 1 by the operation part 30, it can ask for length  $L_{ij}$  (i= 1- 6 and j are positive numbers) of each leg 23 of the parallel mechanism 2. That is, as shown in Table 2, length  $L_{ij}$  of the six legs (it has expressed with the legs 1- 6 in Table 2) 23 in a certain time interval is called for.

[0026]

[Table 2]

時刻	脚 1	脚 2	脚 3	脚 4	脚 5	脚 6
$T_1$	$L_{11}$	$L_{21}$	$L_{31}$	$L_{41}$	$L_{51}$	$L_{61}$
$T_2$	$L_{12}$	$L_{22}$	$L_{32}$	$L_{42}$	$L_{52}$	$L_{62}$
$T_3$	$L_{13}$	$L_{23}$	$L_{33}$	$L_{43}$	$L_{53}$	$L_{63}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$T_r$	$L_{1r}$	$L_{2r}$	$L_{3r}$	$L_{4r}$	$L_{5r}$	$L_{6r}$

[0027]By the way, if the seat 1 is made to rock how in order to train the muscle group which makes the lumbar part a subject for the purpose of prevention of low back pain, or improvement in a balance function, it must be analyzed how the muscle group which makes the lumbar part a subject becomes tense and loosens. Then, when what kind of stimulus (rocking) is given to those who are on a simulator which performs the same operation as people and the horse which are carrying out horse riding, If it surveys how the muscle group which makes the lumbar part a subject becomes tense and loosens, in order to train those muscle groups, it understands what kind of stimulus it should give, and understands what kind of thing is desirable as a rocking pattern given to the seat 1.

[0028]The following methods are adopted for extracting a unit pattern. First, the sphere of reflection 11 is attached to the back and right and left of the circumference of the waist of those who ride on a horse like drawing 4. The myoelectric potential measuring sensor 12 used with a telemeter so that the surface myoelectric potential of the musculus erector spinae, latissimus dorse, a belly oblique muscle on either side, and recti abdominis can be measured is attached. A motion of the sphere of reflection 11 is detected by the motion capture which has arranged two or more sets of high sensitivity TV cameras 13 around the transit route (the arrow A shows the move direction) of a horse like drawing 5, and detects the three- dimensional position information near the lumbar part. In the case of this Measurement Division, surface myoelectric potential and three- dimensional position information double the Measurement Division start time. That is, when the position of the waist changes how by matching by time, it can know which muscles became tense and relaxed how. Specifically, three- dimensional position information like drawing 6 (a) and the measurement data of myoelectric potential like drawing 6 (b) will be matched.

[0029]In extraction of a unit pattern, data may be collected about the person who rode on the simulator which moves like a horse. That is, as shown in drawing 7, it may drive according to the parallel mechanism 2 which mentioned above the seat 1a of the saddle shape, and the same rocking as a horse may be given, and the information on stress and relaxation of the muscle group which carries out three- dimensional position information and lumbar part with a subject may be collected. Since this kind of device is used indoors, it can use a magnetism measuring device as a means to collect the three- dimensional position information on the lumbar part. Three- dimensional position information and the measurement data of myoelectric potential are matched by time like those who have ridden on the horse also in this case.

[0030]By the way, it is thought that the low back pain called low back pain, especially posture lumbago is generated in the following processes. That is, a bone comes to support the truncus directly in the portion of the joint of a pelvis and the backbone, without using muscles, such as a sit- up and the back. This is in the state which stands with the belly near at hand as projected. It stops using a back group (especially musculus erector spinae), and stops next, also using a sit- up after that. In this way, a nerve comes to be suppressed and the symptoms of low back pain are shown. Since the symptoms of low back pain develop in such a process, if it is going to prevent low back pain, it turns out that what is necessary is just to strengthen these muscle groups.

[0031]When this invention persons performed measurement mentioned above, the motion of two rhythm centering on the up- and- down motion corresponding to quick time acquired the knowledge of urging activity of the latissimus dorse located in the back of a navel, and the latissimus dorse of the 50- mm upper part, among the gaits of a horse. Surface myoelectric potential was measured from the recti abdominis of a navel part, and a navel by the recti abdominis on 50 mm, the right-



hand side musculus obliquus externus abdominis, the left-hand side musculus obliquus externus abdominis, and the latissimus dorsi of the back of a navel, and measured it from the navel here at six places of the latissimus dorsi on 50 mm. As a result, the result of urging activity of the muscles of the musculus erector spinae and the back central part to the vibration by quick time among the muscle groups which make the lumbar part a subject was obtained (the three-dimensional position in quick time is shown in drawing 8, and the electromyogram in quick time is shown in drawing 9). drawing 9 (a) -- the recti abdominis of a navel part, and the figure (b) -- a navel -- the right-hand side musculus obliquus externus abdominis and the figure (d) are shown from the latissimus dorsi of the back to the left-hand side musculus obliquus externus abdominis and the figure (e), and, as for the recti abdominis on 50 mm, and the figure (c), the figure (f) shows the latissimus dorsi on 50 mm from a navel. The following electromyograms are also the same. The motion of three rhythm which emphasizes the rotation to order focusing on the up-and-down motion corresponding to gallop acquired the knowledge of urging activity of recti abdominis (the three-dimensional position in gallop is shown in drawing 10, and the electromyogram in gallop is shown in drawing 11). That is, if the motion by quick time and gallop is combined, a sit-up and the back can be strengthened. As the onset process of low back pain mentioned above explained on the other hand, the symptoms of low back pain develop by not using muscles, such as a sit-up and the back. If a sit-up and the back are strengthened, since the onset of low back pain can be prevented, if rocking corresponding to quick time and gallop is given, the onset of low back pain can be prevented.

[0032] According to an above-mentioned viewpoint, the unit pattern corresponding to quick time and gallop is created based on data measuring, and it stores in the data storage part 32. In aiming at prevention of low back pain, it connects serially the unit pattern of quick time as shown in drawing 12 (a) and (b), and gallop stored in the data storage part 32 (in the example of a graphic display, the cycle of T1 and the unit pattern of gallop is set to T2 for the cycle of the unit pattern of quick time). However, since change becomes discontinuous when connecting a different unit pattern, it ties in order to connect both the unit pattern smoothly like drawing 12 (c), and interpolates using a pattern (the cycle of the bond pattern is made into T3).

[0033] Being strengthened with on the other hand training the muscle group which makes the lumbar part a subject also about a balance function is known. According to this invention persons' research, the movement toward the four cycle cadence centering on the up-and-down motion corresponding to a footpace stimulates activity of the musculus obliquus externus abdominis on either side among the gaits of a horse, and the knowledge of using a sit-up to the shake of right and left is acquired (the three-dimensional position in a footpace is shown in drawing 13, and the electromyogram in a footpace is shown in drawing 14).

[0034] However, in order to come to predict a motion in about 2 to 3 seconds to a periodic shake and to strengthen a balance function with a normal person's balance retaining function, there are few effects only at a periodic shake. So, at this embodiment, the abrupt change is given to irregular timing with the acceleration within the limits at which safety is maintained. That is, a change pattern like drawing 15 (b) which contains an abrupt change with a unit pattern like drawing 15 (a) is prepared for the data storage part 32. It is superimposing a change pattern like drawing 15 (b) to irregular timing, although the unit pattern of drawing 15 (a) is connected serially fundamentally. It enables it to give an abrupt change like drawing 15 (c) (in the example of a graphic display, the cycle of the unit pattern of a footpace is set to T4, and the period which superimposes the change pattern is shown as T5).

[0035] As explained above, various kinds of unit patterns, change patterns, etc. are stored in the data storage part 32, and a rocking pattern is generated by connecting a unit pattern serially, interpolating, or superimposing in the operation part 30. Thus, since a rocking pattern is generated by various kinds combining two or more unit patterns, though a small number of unit pattern is used comparatively, a complicated rocking pattern can be generated, and a rocking pattern can be generated economically.

[0036] The rocking pattern generated by the operation part 30 is given to the parallel mechanism 2 through the actuator control parts 33 and the actuator 34 as mentioned above, and the seat 1 rocks it by operation of the parallel mechanism 2. According to a rocking pattern, it can use for prevention of low back pain, or strengthening of a balance function as mentioned above.

(Embodiment 2) Although Embodiment 1 is driving the seat 1 with 6 flexibility of an X axial

direction, Y shaft orientations, Z shaft orientations, and inclination (a roll, a pitch, yaw) of the circumference of the X-axis, the circumference of a Y-axis, and the circumference of the Z-axis, an effect is acquired by prevention of low back pain, and strengthening of a balance function even if it drives the seat 1 with 3 flexibility. In particular, the knowledge that there was a high effect was acquired in Z shaft orientations, a pitch, and the combination of the roll.

[0037]When the seat 1 was driven using the unit pattern of a footpace and the surface myoelectric potential of various muscles was measured about three persons, a result like drawing 16 thru/or drawing 18 was obtained for every everybody. Nine kinds shown in each figure of results The X-axis (\*\*), a Y-axis (\*\*), the Z-axis (\*\*), Only a yaw (\*\*), a pitch (\*\*), and one flexibility each of a roll (\*\*) are results when the seat 1 is driven by nine kinds of each of the combination (\*\*) of a pitch and a roll, the combination (\*\*) of the X-axis, a pitch, and a roll, and the combination (\*\*) of the Z-axis, a pitch, and a roll. It is the percentage of the myoelectric potential in the above-mentioned drive over the myoelectric potential at the time of driving the horizontal axis of each figure by a muscular kind, and driving a vertical axis with 6 flexibility. The result similarly measured about gallop is shown in drawing 19 thru/or drawing 21.

[0038]Although there is dispersion in these measurement results, even when the seat 1 is driven with Z shaft orientations, a pitch, and 3 flexibility of a roll, it turns out that the muscle group which has an effect in prevention of low back pain or strengthening of a balance function can be trained. Therefore, as compared with the case where a parallel mechanism is used as a driving means, reduction of large cost is attained by making the seat 1 rock using the driving means of such 3 flexibility. Other composition and operations are the same as that of Embodiment 1.

[0039](Embodiment 3) According to Embodiment 1, although the unit pattern is stored in the data storage part 32, when the number of the time series data of 6 groups which constitute a unit pattern increases, the big storage capacity as the data storage part 32 will be required. That the number of time series data increases is a case where the time interval of the time series data which constitute the unit pattern was set up short, or the cycle of a unit pattern becomes long.

[0040]So, in this embodiment, while reducing the data volume stored in the data storage part 32, discrete orthogonal transformation has been performed to the time series data which constitute a unit pattern so that grasp of the characteristic of a unit pattern may become easy. A coefficient sequence is extracted by performing discrete Fourier transform to the time series data which specifically constitute a unit pattern. If orthogonal transformation is generally performed, since the feature will concentrate on the coefficient of the low next, even if it omits a high order coefficient, inverse orthogonal transformation can restore the information near the original information. Then, if distortion is allowed to increase somewhat, data volume can be further reduced by omitting a high order coefficient. Thus, if stored in the data storage part 32 by making into a parameter the coefficient sequence searched for from the time series data which constitute a unit pattern, It will mean carrying out the data compression of the unit pattern, and the storage capacity required of the data storage part 32 will be reduced as compared with the case where a unit pattern is stored in the data storage part 32. Since it is concentrating on the coefficient of the low next, the feature of a unit pattern can grasp the feature of a unit pattern easily with a parameter.

[0041]If the parameter stored in the data storage part 32 is used, it can ask for 6 groups of the position of the seat 1 in each time. Such 6 groups are called position data. That is, in the operation part 30, it asks for the position data for every time by inverse orthogonal transformation (inverse Fourier transform) using a parameter. The data flow of Embodiment 1 and the data flow of this embodiment are shown in drawing 22 and drawing 23, respectively. The measuring part 31a from which the data input part 31 detects the three-dimensional position information near people's lumbar part in Embodiment 1 as shown in drawing 22 (a), It comprises the treating part 31b which extracts a unit pattern from the measuring part 31a, and the unit data for which it asked by the treating part 31b is stored in the data storage part 32. Processing which stores a unit pattern in the data storage part 32 is performed apart from the processing which drives the parallel mechanism 2 (it is got blocked, and if processing which drives the parallel mechanism 2 is made into on-line, carried out off-line). When driving the parallel mechanism 2, the unit pattern stored in the data storage part 32 is read like drawing 23 (b), and the signal which drives the parallel mechanism 2 through the control section 35 which consists of the operation part 30, the actuator control parts 33, and the actuator 34 is generated. The operation part 30 is made to serve a double purpose also as a calculating means as mentioned above.

[0042]The measuring part 31a from which the data input part 31, on the other hand, detects the three-dimensional position information near people's lumbar part by this embodiment as shown in drawing 23 (a). It is constituted by the treating part 31b which extracts a unit pattern from the measuring part 31a, and the electrical-parameter-extraction part 31c which performs discrete Fourier transform to a unit pattern, and extracts a parameter. The parameter for which it asked in the electrical-parameter-extraction part 31c is stored in the data storage part 32. For example, a parameter can be obtained in a form as shown in Table 3 to the unit pattern shown in Table 1. It is  $n > N$  here. That is, the parameter of the number becomes less than the time series data of a unit pattern.

[0043]

[Table 3]

X	Y	Z	ロール	ピッチ	ヨー
$A_{x1}$	$A_{y1}$	$A_{z1}$	$A\theta_{x1}$	$A\theta_{y1}$	$A\theta_{z1}$
$A_{x2}$	$A_{y2}$	$A_{z2}$	$A\theta_{x2}$	$A\theta_{y2}$	$A\theta_{z2}$
$A_{xn}$	$A_{yn}$	$A_{zn}$	$A\theta_{xn}$	$A\theta_{yn}$	$A\theta_{zn}$
.....	.....	.....	.....	.....	.....
$A_{xN}$	$A_{yN}$	$A_{zN}$	$A\theta_{xN}$	$A\theta_{yN}$	$A\theta_{zN}$

[0044]When driving the parallel mechanism 2, as shown in drawing 23 (b), inverse Fourier transform is performed to the parameter stored in the data storage part 32 by the operation part 30 which is a calculating means, and it asks for the position data of each time. Position data is generated in a form as 6 groups of each time  $t$  of every as shown in Table 4.

[0045]

[Table 4]

時刻	X	Y	Z	ロール	ピッチ	ヨー
$t$	$X_1$	$Y_1$	$Z_1$	$\theta_{x1}$	$\theta_{y1}$	$\theta_{z1}$

[0046]The operation part 30 performs inverse kinematics calculation like Embodiment 1, for example, as shown in Table 5, it asks for length  $L_{it}$  (it is shown that  $i = 1 - 6$  and  $t$  are data of the time  $t$ ) of each leg 23 of the parallel mechanism 2 from position data.

[0047]

[Table 5]

時刻	脚 1	脚 2	脚 3	脚 4	脚 5	脚 6
$t$	$L_{1t}$	$L_{2t}$	$L_{3t}$	$L_{4t}$	$L_{5t}$	$L_{6t}$

[0048]Length  $L_{it}$  of the leg 23 of the parallel mechanism 2 is given to the parallel mechanism 2 through the control section 35 which consists of the actuator control parts 33 and the actuator 34, and the parallel mechanism 2 drives it. By the way, the case where the parallel mechanism 2 is driven by repetition of a unit pattern as mentioned above, Since the rocking pattern for every cycle becomes the same when driving the parallel mechanism 2 using a parameter, the seat 1 becomes a periodic and monotonous motion and there is a problem of a user getting bored or coming to maintain balance without a user's getting used to a motion and using the waist. Then, since change is given to movement of the seat 1, there is independent [ no ], it combines and various kinds of following art is used.

[0049]that is, it is shown in Table 6 -- as -- each element of 6 groups of position data (or time series data which constitute a unit pattern) -- variation value  $\alpha_{Nt}$  ( $N = X, Y, Z, \theta_{x_t}, \theta_{y_t},$  and  $\theta_{z_t}$ )  $t$  -- the data of the time  $t$  -- meaning -- it asks for length  $L_{it}$  of the leg 23 of the

parallel mechanism 2 by performing inverse kinematics conversion to the position data which added and added variation value  $\alpha_{Nt}$ . Variation value  $\alpha_{Nt}$  can make it generate here by random numbers. It may be variation value  $\alpha_{Nt}$  which contains 1/f fluctuation. However, the amplitude of variation value  $\alpha_{Nt}$  is set up smaller than the amplitude of the original position data, and even after adding variation value  $\alpha_{Nt}$ , it is made to be reflected in position data.

[0050]

[Table 6]

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$X -$ $+ \alpha_{x1}$	$Y -$ $+ \alpha_{y1}$	$Z -$ $+ \alpha_{z1}$	$\theta_{x1}$ $+ \alpha \theta_{x1}$	$\theta_{y1}$ $+ \alpha \theta_{y1}$	$\theta_{z1}$ $+ \alpha \theta_{z1}$

[0051]In order to give change to rocking of the seat 1, as shown in Table 7, the multiplication of the coefficient  $\beta_{Nt}$  ( $N=X, Y, Z, \theta_{x1}, \theta_{y1}, \theta_{z1}$ ) is carried out to at least one of each elements of 6 groups which constitute position data. In Table 7, the multiplication of the coefficient  $\beta_{Nt}$  is carried out to all the elements. Thus, if the multiplication of the coefficient  $\beta_{Nt}$  is carried out, the amplitude which makes the seat 1 rock with the size of coefficient  $\beta_{Nt}$  can be changed.

[0052]

[Table 7]

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$\beta_x X -$	$\beta_y Y -$	$\beta_z Z -$	$\beta \theta_{x1}$ $\cdot \theta_{x1}$	$\beta \theta_{y1}$ $\cdot \theta_{y1}$	$\beta \theta_{z1}$ $\cdot \theta_{z1}$

[0053]If the time interval which carries out inverse kinematics conversion of the 6 groups which constitute position data as shown in Table 8 is changed (time is multiplied by the coefficient gamma in Table 8), the cycle of position data can be changed and the speed of a motion of the seat 1 can be changed. Other composition and operations are the same as that of Embodiment 1.

[0054]

[Table 8]

時刻	X	Y	Z	ロール	ピッチ	ヨー
$\gamma t$	$X_{11}$	$Y_{11}$	$Z_{11}$	$\theta_{x11}$	$\theta_{y11}$	$\theta_{z11}$

[0055]

[Effect of the Invention]The invention of Claim 1 gives compulsory rocking to a seat so that the muscle group which makes the lumbar part a subject in the state where it sat down on the seat may become tense and loosen. It is what measures the state of the stress and relaxation of a muscle group which makes a subject the three-dimensional position information and lumbar part near the lumbar part, and matches both. In order to strengthen the muscle group which matches activity of the muscle group which carries out the position change and the lumbar part near the lumbar part with a subject, and is useful for prevention of low back pain, or strengthening of a balance function, it is easily analyzable what kind of position change should be given to the lumbar part.

[0056]At the same time it starts Measurement Division of the three-dimensional position information near the lumbar part using the motion capture which has arranged two or more sets of TV cameras, while a seat is the saddle attached to the horse and attaching a sphere of reflection near the lumbar part like the invention of Claim 2. Since motion capture is used, following in footsteps of a motion [ a actual horse ] is possible what starts Measurement Division of the surface myoelectric potential of the spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis.

[0057]A seat is a seat of the simulator which imitates the motion on a saddle like the invention of

Claim 3, In what starts Measurement Division of the surface myoelectric potential of the spine standing-up sources by a telemeter, latissimus dorse, a belly oblique muscle on either side, and recti abdominis, it becomes possible to create data indoors, without actually running a horse at the same time it starts Measurement Division of the three-dimensional position information near the lumbar part using a magnetism measuring device.

[0058]Like the invention [\*\*\*\* / extracting the information about the three-dimensional impaction efficiency near / suitable for training of the muscle group relevant to prevention of low back pain / the lumbar part from the measuring result of Claim 1 thru/or Claim 3 like the invention of Claim 4] of Claim 5, If the information about the three-dimensional impaction efficiency near [ suitable for training of the muscle group relevant to balance maintenance ] the lumbar part is extracted from the measuring result of Claim 1 thru/or Claim 3, a motion of near the lumbar part suitable for prevention of low back pain or training of balance maintenance can be known.

[0059]The driving means which the invention of Claim 6 makes rock the seat where a trainee sits down, and a seat by a three dimension, Have a control means which directs the position of a seat to a driving means, the position of the seat in each time is determined by the information about the three-dimensional impaction efficiency near [ suitable for prevention of the low back pain extracted with Claim 4 or the movement analytical method of Claim 5 ] the lumbar part, and a trainee only sits down on a seat, The muscle group which makes the lumbar part a subject can be strengthened without doing one's best especially in muscular strengthening, and there is an advantage that prevention of low back pain and strengthening of a balance function can be performed.

[0060]It has a data storage means which stores the unit pattern of the position of a seat for which it asked from the information about the three-dimensional impaction efficiency near [ which has the periodicity extracted corresponding to the quick time and gallop of a horse, respectively like the invention of Claim 7 ] the lumbar part, If the unit pattern repeatedly read from a data storage means is given to a driving means, a control means, Prevention of low back pain has an effect and it has a data storage means which stores the unit pattern of the position of a seat for which it asked from the information about the three-dimensional impaction efficiency near [ which has the periodicity extracted corresponding to the footpace of a horse like the invention of Claim 8 ] the lumbar part, If a control means superimposes the change pattern accompanied by a sudden change on the unit pattern repeatedly read from a data storage means to irregular timing and it is given to a driving means, strengthening of a balance function has an effect.

[0061]A driving means like the invention of Claim 9 by what is constituted by 3 flexibility so that a seat may be made to rock about a sliding direction, a roll, and a pitch. While the same effect as the case where the driving means of 6 flexibility is used can be realized by the driving means of 3 flexibility and generation of a unit pattern becomes easy, it has the advantage that cost can be reduced also about a mechanism.

[0062]The driving means which the invention of Claim 10 makes rock the seat where a trainee sits down, and a seat by a three dimension, The control means which directs the position of a seat to a driving means, An electrical-parameter-extraction means to perform orthogonal transformation to the unit pattern of the position of a seat for which it asked from the information about the three-dimensional impaction efficiency near [ which has the periodicity extracted with Claim 4 or the movement analytical method of Claim 5 ] the lumbar part, and to ask for a coefficient group as a parameter, It is a thing provided with the calculating means given to a control means in quest of the position data which consists of two or more elements which show the position of the seat of each time using the parameter stored in the data storage means which memorizes a parameter, and the parameter storage means, Since what is necessary is just to store the parameter with little data volume in the data storage means as compared with the unit pattern in addition to the same effect as the invention of Claim 6, there is an advantage that the data volume stored in the data storage means can be reduced.

[0063]A calculating means like the invention of Claim 11 by what adds the variation value of a random number to each element of position data, and is given to a control means. Since the random number is added to position data, if the amplitude of the random number added to position data is small set up as compared with the amplitude of the time series of position data, Not to mention stopping being a periodic and monotonous motion and the effect of prevention of low back pain or relaxation being acquired, though a motion of a seat reflects position data, It can prevent

weariness arising or coming to maintain balance, without a habituation using the muscles of the lumbar part, and a high effect can be acquired to strengthening of the muscle group which makes the lumbar part a subject.

[0064]In what adds the variation value to which a calculating means has  $1/f$  fluctuation in each element of position data like the invention of Claim 12, and is given to a control means. Since  $1/f$  fluctuation is contained in rocking of a seat, in addition to the same effect as the invention of Claim 11, it can be made the motion including the natural fluctuation which is not a mechanical and unnatural motion about a seat. A calculating means like the invention of Claim 13 by what carries out the multiplication of the coefficient to at least 1 element of position data, and is given to a control means. Since the amplitude which a seat rocks by setting up a coefficient suitably can be changed in addition to the same effect as the invention of Claim 6, there is an advantage that the strength of rocking is changeable according to a user's degree of acquisition and habituation.

[0065]By what was made variable, the time interval which gives position data to a control means from a calculating means like the invention of Claim 14. By changing the time interval which gives position data to a control means in addition to the same effect as the invention of Claim 6, the repeating cycle of rocking of a seat changes and there is an advantage that change can be given to the speed which a seat rocks.

---

[Translation done.]

## \* NOTICES \*

**JP and INPIT are not responsible for any damages caused by the use of this translation.**

1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

---

DESCRIPTION OF DRAWINGS

---

[Brief Description of the Drawings]

[Drawing 1]It is a perspective view of Embodiment 1.

[Drawing 2]It is a perspective view showing the parallel mechanism used for the same as the above.

[Drawing 3]It is a block diagram same as the above.

[Drawing 4]It is an explanatory view of three- dimensional position information same as the above and the measuring method of myoelectric potential.

[Drawing 5]It is an explanatory view of the measuring method of three- dimensional position information same as the above.

[Drawing 6]It is a figure showing three- dimensional position information same as the above and the measurement result of myoelectric potential.

[Drawing 7]An example of the simulator used for the same as the above is shown, (a) is a side view and (b) is a rear elevation.

[Drawing 8]It is a figure showing the three- dimensional position in quick time in the same as the above.

[Drawing 9]It is a figure showing the electromyogram in quick time in the same as the above.

[Drawing 10]It is a figure showing the three- dimensional position in gallop in the same as the above.

[Drawing 11]It is a figure showing the electromyogram in gallop in the same as the above.

[Drawing 12]It is an explanatory view showing generation of the rocking pattern of the low back pain prevention from a unit pattern in the same as the above.

[Drawing 13]It is a figure showing the three- dimensional position in a footpace in the same as the above.

[Drawing 14]It is a figure showing the electromyogram in a footpace in the same as the above.

[Drawing 15]It is an explanatory view showing generation of the rocking pattern of balance function strengthening from a unit pattern in the same as the above.

[Drawing 16]It is a figure showing the measurement result corresponding to Embodiment 2.

[Drawing 17]It is a figure showing the measurement result corresponding to Embodiment 2.

[Drawing 18]It is a figure showing the measurement result corresponding to Embodiment 2.

[Drawing 19]It is a figure showing the measurement result corresponding to Embodiment 2.

[Drawing 20]It is a figure showing the measurement result corresponding to Embodiment 2.

[Drawing 21]It is a figure showing the measurement result corresponding to Embodiment 2.

[Drawing 22]It is a block diagram of Embodiment 1 shown as a comparative example with Embodiment 3.

[Drawing 23]It is a block diagram showing Embodiment 3.

[Description of Notations]

1 Seat

2 Parallel mechanism

3 Control device

11 Sphere of reflection

12 Myoelectric potential measuring sensor

13 TV camera

30 Operation part

31 Data input part  
31a Measuring part  
31b Treating part  
31c Electrical- parameter- extraction part  
32 Data storage part  
33 Actuator control parts  
34 Actuator  
35 Control section

---

[Translation done.]



(19) 日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11) 特許出願公開番号

特開平11-155836

(43) 公開日 平成11年(1999) 6 月15日

(51) Int.Cl.<sup>8</sup>

識別記号

F I

A 6 1 B 5/11  
A 6 3 B 23/035  
A 6 3 K 3/00

A 6 1 B 5/10 3 1 0 Z  
A 6 3 B 23/035  
A 6 3 K 3/00

審査請求 未請求 請求項の数14 O L (全 15 頁)

(21) 出願番号 特願平10-63717

(22) 出願日 平成10年(1998) 3 月13日

(31) 優先権主張番号 特願平9-260705

(32) 優先日 平 9 (1997) 9 月25日

(33) 優先権主張国 日本 (J P)

(71) 出願人 000005832

松下電工株式会社

大阪府門真市大字門真1048番地

(72) 発明者 村上 宗司

大阪府門真市大字門真1048番地松下電工株式会社内

(72) 発明者 関根 修

大阪府門真市大字門真1048番地松下電工株式会社内

(72) 発明者 四宮 葉一

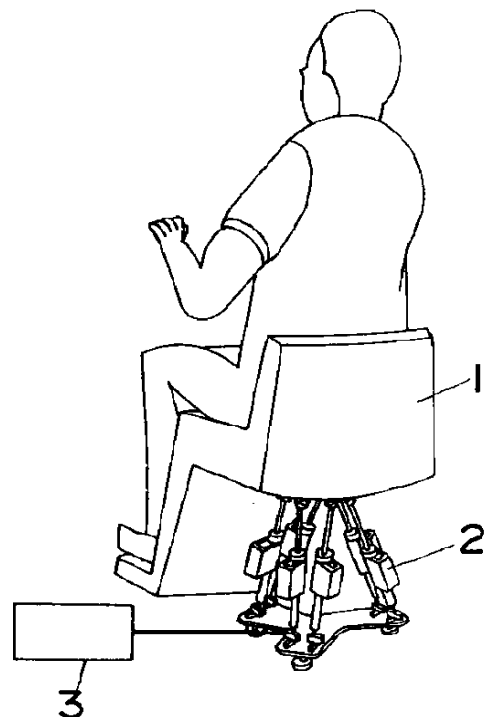
大阪府門真市大字門真1048番地松下電工株式会社内

(74) 代理人 弁理士 西川 恵清 (外 1 名)

最終頁に続く

(54) 【発明の名称】 運動分析方法および運動補助装置

(57) y v æ  
y Ł z h ~ o 意  
Q > 意  
y Ł i z n ` % l 車  
æ ~ • Ø 車  
A ¥ h o X 車  
P ß • Ø % K v " 車  
o • Ø B P ß " 車  
/ o • % p ^ [ ' 車  
† " Ø - ~ Ł A 車  
A % 車





a } Ø ^ fi 絲  
 y O O Ө z 絲  
 y L 絲  
 • Ø / > S I " h fi 絲  
 ‡ ° u æ ~ ... t fl ~ 絲  
 @ Ө fi A ~ t fl ~ 絲  
 > » S ^ f Ө Q > » 絲  
 ° u ~ » A R ‡ i - p ‡ ~ 絲  
 Ø B fi ~ ° ~ X « 絲  
 a " ~ ° ~ 絲  
 y O O O T z ¿ Q > 絲  
 ~ A " " n fl Ø ~ 絲  
 [ V L J n • Ø ~ 絲  
 æ v " J n A ¶ E - 絲  
 N S A L w • Ø ‡ 絲  
 v " J n • Ø ‡ 絲  
 L v - p ‡ Ø ' 絲  
 " / Ƴ - 絲  
 y O O O U z ¿ R > 絲  
 ~ A " " ~ a fi « " 絲  
 ' ~ A Ƴ C v " n • Ø ~ 絲  
 æ v " J n A ¶ E - 絲  
 N S A L w • Ø ‡ 絲  
 v " J n • Ø ‡ 絲  
 p ‡ Ø - " > A " - f 絲  
 " Ө 絲  
 y O O O V z ¿ S > 絲  
 R O v " ° ' R ‡ h 絲  
 K • Ø - Ø B ¿ ' o T 絲  
 P ß K % Ө Ө t 絲  
 y O O O W z ¿ S A ¿ 絲  
 l - Ø Ө B ¿ U - h > 絲  
 " ~ A " R ‡ f • Ø S fi 絲  
 u fi Ø " L i w f ¿ S S 絲  
 @ ° L o u fi • Ø æ P ß 絲  
 - Ƴ < Ө ° A P • 絲  
 ~ > Q > » • Ø - " - 絲  
 Ƴ > » " s " 絲  
 y O O O X z ¿ V > 絲

~ A n < ~ ~  
 œ « L • Ø t u R 絲  
 ' fl L i 1 f A S ° p L P i 絲  
 L Ө O O P O z ¿ W > 絲  
 y O A n R ‡ ° u ~ fi 絲  
 ~ t ° u P ° p ^ [ i [ 絲

5

Ø - ~ " Ⅹ

Y O O P S z ǐ P Q Ⅹ

Ⅹ ǐ ~ A O L Z ǐ i " A Ⅹ

< > » l Ⅹ Z Ⅹ

Ø B - Ⅹ < Ⅹ A Ⅹ

Ⅹ Ø ' A ǐ P P Ⅹ

~ A " h fi @ B I - Ⅹ

< " Ⅹ Ⅹ

Y O O P T z ǐ P R Ⅹ

Ⅹ ǐ ~ A O L Z ǐ i " A Ⅹ 10

f W Z ~ S ǐ Ⅹ

Ⅹ < Ⅹ A ǐ U Ⅹ

W ~ K X ǐ • Ø - ~ Ⅹ

> » ‡ " Ø - ~ " - « Ø Ⅹ

Ⅹ ~ h fi > ‡ Ⅹ

Y O O P U z ǐ P S Ⅹ

Ⅹ ǐ ~ A O L Z ǐ i ' Ⅹ

Ø u Ⅹ % Ⅹ

Ⅹ A ǐ U > ~ fi l Ⅹ

S ǐ i ^ f Ø Ⅹ 20

h fi J ǐ œ " ~ » Ⅹ

> ^ f Ø - Ⅹ

Y O O P z

Y > { ^ z i Ⅹ

P f • / A P β Ⅹ

~ ~ p J j Y Ⅹ

J j Y Q fi S Ⅹ

S u R Ⅹ

Y O O P W z p J Ⅹ

A ǐ ° u Ⅹ ǐ ‡ Ⅹ Ø - Ⅹ 30

f Ø B e r Q R " A - ǐ Ⅹ

50

‡ j ~ A w † i C x C y i "

A s b \ x Ⅹ Ⅹ C Ⅹ i " ‡ j

U ' g Ⅹ œ ǐ • Ø / u - Ⅹ

ǐ A œ « Ⅹ Ø Ⅹ A U Ⅹ

i [ ‡ Ⅹ ~ ǐ Ø B " " - " Ⅹ

[ P ° p ^ [ ~ ǐ / Ⅹ

7  
 8  
 9  
 10  
 11  
 12  
 13  
 14  
 15  
 16  
 17  
 18  
 19  
 20  
 21  
 22  
 23  
 24  
 25  
 26  
 27  
 28  
 29  
 30  
 31  
 32  
 33  
 34  
 35  
 36  
 37  
 38  
 39  
 40  
 41  
 42  
 43  
 44  
 45  
 46  
 47  
 48  
 49  
 50  
 51  
 52  
 53  
 54  
 55  
 56  
 57  
 58  
 59  
 60  
 61  
 62  
 63  
 64  
 65  
 66  
 67  
 68  
 69  
 70  
 71  
 72  
 73  
 74  
 75  
 76  
 77  
 78  
 79  
 80  
 81  
 82  
 83  
 84  
 85  
 86  
 87  
 88  
 89  
 90  
 91  
 92  
 93  
 94  
 95  
 96  
 97  
 98  
 99  
 100  
 101  
 102  
 103  
 104  
 105  
 106  
 107  
 108  
 109  
 110  
 111  
 112  
 113  
 114  
 115  
 116  
 117  
 118  
 119  
 120  
 121  
 122  
 123  
 124  
 125  
 126  
 127  
 128  
 129  
 130  
 131  
 132  
 133  
 134  
 135  
 136  
 137  
 138  
 139  
 140  
 141  
 142  
 143  
 144  
 145  
 146  
 147  
 148  
 149  
 150  
 151  
 152  
 153  
 154  
 155  
 156  
 157  
 158  
 159  
 160  
 161  
 162  
 163  
 164  
 165  
 166  
 167  
 168  
 169  
 170  
 171  
 172  
 173  
 174  
 175  
 176  
 177  
 178  
 179  
 180  
 181  
 182  
 183  
 184  
 185  
 186  
 187  
 188  
 189  
 190  
 191  
 192  
 193  
 194  
 195  
 196  
 197  
 198  
 199  
 200  
 201  
 202  
 203  
 204  
 205  
 206  
 207  
 208  
 209  
 210  
 211  
 212  
 213  
 214  
 215  
 216  
 217  
 218  
 219  
 220  
 221  
 222  
 223  
 224  
 225  
 226  
 227  
 228  
 229  
 230  
 231  
 232  
 233  
 234  
 235  
 236  
 237  
 238  
 239  
 240  
 241  
 242  
 243  
 244  
 245  
 246  
 247  
 248  
 249  
 250  
 251  
 252  
 253  
 254  
 255  
 256  
 257  
 258  
 259  
 260  
 261  
 262  
 263  
 264  
 265  
 266  
 267  
 268  
 269  
 270  
 271  
 272  
 273  
 274  
 275  
 276  
 277  
 278  
 279  
 280  
 281  
 282  
 283  
 284  
 285  
 286  
 287  
 288  
 289  
 290  
 291  
 292  
 293  
 294  
 295  
 296  
 297  
 298  
 299  
 300  
 301  
 302  
 303  
 304  
 305  
 306  
 307  
 308  
 309  
 310  
 311  
 312  
 313  
 314  
 315  
 316  
 317  
 318  
 319  
 320  
 321  
 322  
 323  
 324  
 325  
 326  
 327  
 328  
 329  
 330  
 331  
 332  
 333  
 334  
 335  
 336  
 337  
 338  
 339  
 340  
 341  
 342  
 343  
 344  
 345  
 346  
 347  
 348  
 349  
 350  
 351  
 352  
 353  
 354  
 355  
 356  
 357  
 358  
 359  
 360  
 361  
 362  
 363  
 364  
 365  
 366  
 367  
 368  
 369  
 370  
 371  
 372  
 373  
 374  
 375  
 376  
 377  
 378  
 379  
 380  
 381  
 382  
 383  
 384  
 385  
 386  
 387  
 388  
 389  
 390  
 391  
 392  
 393  
 394  
 395  
 396  
 397  
 398  
 399  
 400  
 401  
 402  
 403  
 404  
 405  
 406  
 407  
 408  
 409  
 410  
 411  
 412  
 413  
 414  
 415  
 416  
 417  
 418  
 419  
 420  
 421  
 422  
 423  
 424  
 425  
 426  
 427  
 428  
 429  
 430  
 431  
 432  
 433  
 434  
 435  
 436  
 437  
 438  
 439  
 440  
 441  
 442  
 443  
 444  
 445  
 446  
 447  
 448  
 449  
 450  
 451  
 452  
 453  
 454  
 455  
 456  
 457  
 458  
 459  
 460  
 461  
 462  
 463  
 464  
 465  
 466  
 467  
 468  
 469  
 470  
 471  
 472  
 473  
 474  
 475  
 476  
 477  
 478  
 479  
 480  
 481  
 482  
 483  
 484  
 485  
 486  
 487  
 488  
 489  
 490  
 491  
 492  
 493  
 494  
 495  
 496  
 497  
 498  
 499  
 500  
 501  
 502  
 503  
 504  
 505  
 506  
 507  
 508  
 509  
 510  
 511  
 512  
 513  
 514  
 515  
 516  
 517  
 518  
 519  
 520  
 521  
 522  
 523  
 524  
 525  
 526  
 527  
 528  
 529  
 530  
 531  
 532  
 533  
 534  
 535  
 536  
 537  
 538  
 539  
 540  
 541  
 542  
 543  
 544  
 545  
 546  
 547  
 548  
 549  
 550  
 551  
 552  
 553  
 554  
 555  
 556  
 557  
 558  
 559  
 560  
 561  
 562  
 563  
 564  
 565  
 566  
 567  
 568  
 569  
 570  
 571  
 572  
 573  
 574  
 575  
 576  
 577  
 578  
 579  
 580  
 581  
 582  
 583  
 584  
 585  
 586  
 587  
 588  
 589  
 590  
 591  
 592  
 593  
 594  
 595  
 596  
 597  
 598  
 599  
 600  
 601  
 602  
 603  
 604  
 605  
 606  
 607  
 608  
 609  
 610  
 611  
 612  
 613  
 614  
 615  
 616  
 617  
 618  
 619  
 620  
 621  
 622  
 623  
 624  
 625  
 626  
 627  
 628  
 629  
 630  
 631  
 632  
 633  
 634  
 635  
 636  
 637  
 638  
 639  
 640  
 641  
 642  
 643  
 644  
 645  
 646  
 647  
 648  
 649  
 650  
 651  
 652  
 653  
 654  
 655  
 656  
 657  
 658  
 659  
 660  
 661  
 662  
 663  
 664  
 665  
 666  
 667  
 668  
 669  
 670  
 671  
 672  
 673  
 674  
 675  
 676  
 677  
 678  
 679  
 680  
 681  
 682  
 683  
 684  
 685  
 686  
 687  
 688  
 689  
 690  
 691  
 692  
 693  
 694  
 695  
 696  
 697  
 698  
 699  
 700  
 701  
 702  
 703  
 704  
 705  
 706  
 707  
 708  
 709  
 710  
 711  
 712  
 713  
 714  
 715  
 716  
 717  
 718  
 719  
 720  
 721  
 722  
 723  
 724  
 725  
 726  
 727  
 728  
 729  
 730  
 731  
 732  
 733  
 734  
 735  
 736  
 737  
 738  
 739  
 740  
 741  
 742  
 743  
 744  
 745  
 746  
 747  
 748  
 749  
 750  
 751  
 752  
 753  
 754  
 755  
 756  
 757  
 758  
 759  
 760  
 761  
 762  
 763  
 764  
 765  
 766  
 767  
 768  
 769  
 770  
 771  
 772  
 773  
 774  
 775  
 776  
 777  
 778  
 779  
 780  
 781  
 782  
 783  
 784  
 785  
 786  
 787  
 788  
 789  
 790  
 791  
 792  
 793  
 794  
 795  
 796  
 797  
 798  
 799  
 800  
 801  
 802  
 803  
 804  
 805  
 806  
 807  
 808  
 809  
 810  
 811  
 812  
 813  
 814  
 815  
 816  
 817  
 818  
 819  
 820  
 821  
 822  
 823  
 824  
 825  
 826  
 827  
 828  
 829  
 830  
 831  
 832  
 833  
 834  
 835  
 836  
 837  
 838  
 839  
 840  
 841  
 842  
 843  
 844  
 845  
 846  
 847  
 848  
 849  
 850  
 851  
 852  
 853  
 854  
 855  
 856  
 857  
 858  
 859  
 860  
 861  
 862  
 863  
 864  
 865  
 866  
 867  
 868  
 869  
 870  
 871  
 872  
 873  
 874  
 875  
 876  
 877  
 878  
 879  
 880  
 881  
 882  
 883  
 884  
 885  
 886  
 887  
 888  
 889  
 890  
 891  
 892  
 893  
 894  
 895  
 896  
 897  
 898  
 899  
 900  
 901  
 902  
 903  
 904  
 905  
 906  
 907  
 908  
 909  
 910  
 911  
 912  
 913  
 914  
 915  
 916  
 917  
 918  
 919  
 920  
 921  
 922  
 923  
 924  
 925  
 926  
 927  
 928  
 929  
 930  
 931  
 932  
 933  
 934  
 935  
 936  
 937  
 938  
 939  
 940  
 941  
 942  
 943  
 944  
 945  
 946  
 947  
 948  
 949  
 950  
 951  
 952  
 953  
 954  
 955  
 956  
 957  
 958  
 959  
 960  
 961  
 962  
 963  
 964  
 965  
 966  
 967  
 968  
 969  
 970  
 971  
 972  
 973  
 974  
 975  
 976  
 977  
 978  
 979  
 980  
 981  
 982  
 983  
 984  
 985  
 986  
 987  
 988  
 989  
 990  
 991  
 992  
 993  
 994  
 995  
 996  
 997  
 998  
 999  
 1000

時刻	X	Y	Z	ロール	ピッチ	ヨー
$T_1$	$X_1$	$Y_1$	$Z_1$	$\theta_{x1}$	$\theta_{y1}$	$\theta_{z1}$
$T_2$	$X_2$	$Y_2$	$Z_2$	$\theta_{x2}$	$\theta_{y2}$	$\theta_{z2}$
$T_3$	$X_3$	$Y_3$	$Z_3$	$\theta_{x3}$	$\theta_{y3}$	$\theta_{z3}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$T_n$	$X_n$	$Y_n$	$Z_n$	$\theta_{xn}$	$\theta_{yn}$	$\theta_{zn}$

Y O O Q T z ¥ P / " 夢 f Q - " r P 、 U - ¥ 夢 "

^ ♢ ~ A Z R O - ¥ 夢 夢

w v Z { • ~ p 夢 Y O O Q

kj i P 、 U A " + 夢 Y ¥ Q

、 L A ¥ Q / A 夢 f

時刻	脚1	脚2	脚3	脚4	脚5	脚6
$T_1$	$L_{11}$	$L_{21}$	$L_{31}$	$L_{41}$	$L_{51}$	$L_{61}$
$T_2$	$L_{12}$	$L_{22}$	$L_{32}$	$L_{42}$	$L_{52}$	$L_{62}$
$T_3$	$L_{13}$	$L_{23}$	$L_{33}$	$L_{43}$	$L_{53}$	$L_{63}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$T_n$	$L_{1n}$	$L_{2n}$	$L_{3n}$	$L_{4n}$	$L_{5n}$	$L_{6n}$

Y O O Q V z ~ - ° - A 夢 æ o • Ø B - v " 夢

a A " P ' / h 夢 ° u æ ~ " v " J n ~ - 夢

Ø " Q " ' / f % ~ « A ' " ' 夢

£ " ♢ B » - - A 夢 Ø - ~ " - « Ø B I 夢

fi s " / / " V ~ 夢 ° u æ ~ } U i j 夢

/ " h i h fi j " ^ f 夢 " . t fl 夢

• Ø Q " ' / 夢 Y O O Q X z P ° p ^ [ 夢

. A » 夢 Q P B 夢 V ~ [ ^ A } V f • 夢

^ f 夢 ' " ' L 夢 40 ♢ B ' L A } 夢

~ ~ ' / " 夢 % p f A R + ° u æ 夢

Y O O Q W z P ° p ^ [ 夢 ^ f A R + ° u æ 夢

p • Ø B , A n Ø 夢 f E o æ ~ B W 夢

} S / % , P P 夢 u " fi - p ♢ Ø ' A 夢

A L w A ¶ E . 夢 W • Ø L i ~ " ¥ C v 夢

• Ø - ~ " - « Ø / e 夢 Ø B - 夢 n 、 ~ 夢

Z T P Q L t fl Ø B 夢 Ø B ~ d ° " L f [ ^ 夢

/ " i o H i fi 夢 Ø B O O R O z ~ - ° - A 夢

[ V L v 、 - o 夢 50 Ø " A " " / " v 夢

9  
 ~ ¢ Ø B ' L A w P  
 ~ w " - " 10  
 Ø B - E " O , « o 10  
 - Ø B A w Q i ~ 10  
 " L A » a A g 10  
 ‡ E Ø / " L 10  
 X - " > ' • Ø - 10  
 • E , A - E Q 10  
 Ø B  
 y O O R P z { > " 10  
 ' ~ A n l / < 10  
 % Q q fi « " A » 10  
 T O a L w 10  
 % B - - A ¥ ° d ° " 10  
 T O a ... A E / 10  
 A » ^ L w A 10  
 U - " L % B » 10  
 ~ • Ø Q / < 10  
 fi f • ~ ¢ / 10  
 - R ‡ ° u A } X 20  
 % A } X i j " » 20  
 L T O a ... A fl 20  
 fl } i j " / O , 20  
 L w A fl } i j ~ 20  
 f • B " " d } fl l 20  
 • Ø a " fi S O a 20  
 « " A ... fi f • 20  
 - R ‡ ° u A } 20  
 • j B ' L A < ~ 20  
 " w > » • Ø 30  
 % > ' v Z X - 30  
 ' g " ¢ - ~ 30  
 L A " - « Ø ' A < ~ 30  
 - ~ " - > ' ¥ h • 30  
 E , > ' 30  
 y O O R Q z a q ~ 30  
 " P 30  
 fl R Q i [ ~ " > B 30  
 " A f [ ^ L fl R Q 30  
 i j / " < " 40

① j A 本  
 i② j A ③ j A ④ j A s ⑤ j A [ 10  
 ⑥ j e P ' R x A s 10  
 ⑦ j A w t ~ s b ~ ~ 10  
 i⑧ j A y t ~ s b ~ ~ ⑨ j 10  
 X » E ... E - " P 10  
 50 Ø B % A e } i t " 10

fi % E d ° 遺  
 “ f - Ø B ‡ A 風  
 ° } P X “ † 櫻  
 y O O R W z - E “ L 奏  
 y † ß A s b 、 A [ 霞  
 % E - ¥ h o 意  
 Ø Q P ß • Ø - ~ “ 露  
 、 ~ A - / “ R ’ R x 通  
 h fi ‡ “ Ø - ~ 、 ~ A 証  
 j Y p † Ø E r 夢 10  
 ¥ “ Ø B ... ¥ < n 卑  
 Ø B  
 y O O R X z i { 、 R 專  
 fl R Q P ° p ^ [ 獲  
 ¥ < • Ø U ’ g n 霽  
 ~ A f [ ^ L fl R Q ~ 露  
 Ø - ~ “ Ø B n æ f [ 風  
 ° p ^ [ ¥ < ~ † Ø 垂

X	Y	Z	ロール	ピッチ	ヨー
$A_{x1}$	$A_{y1}$	$A_{z1}$	$A\theta_{x1}$	$A\theta_{y1}$	$A\theta_{z1}$
$A_{x2}$	$A_{y2}$	$A_{z2}$	$A\theta_{x2}$	$A\theta_{y2}$	$A\theta_{z2}$
$A_{x3}$	$A_{y3}$	$A_{z3}$	$A\theta_{x3}$	$A\theta_{y3}$	$A\theta_{z3}$
.....	.....	.....	.....	.....	.....
$A_{xN}$	$A_{yN}$	$A_{zN}$	$A\theta_{xN}$	$A\theta_{yN}$	$A\theta_{zN}$

13  
 Ⅲ % p [ ^ . ~ Ⅲ - Ⅲ < Ⅲ  
 t [ G ~ • s " ¢ e Ⅲ y O O Ⅲ z  
 u f [ ^ " A e t ~ Ⅲ y ¥ Ⅲ

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$X_t$	$Y_t$	$Z_t$	$\theta_{x_t}$	$\theta_{y_t}$	$\theta_{z_t}$

y O O S U z Z R O ~ Ⅲ f U C ~ Ⅲ f [ ^ - Ⅲ  
 v Z s " ¢ A % ~ f . A Ⅲ y O O Ⅲ  
 p J j Y Ⅲ i Pf10

時刻	脚1	脚2	脚3	脚4	脚5	脚6
t	$L_{1t}$	$L_{2t}$	$L_{3t}$	$L_{4t}$	$L_{5t}$	$L_{6t}$

y O O S W z p J Ⅲ i > ~ P ° p ^ [ Ⅲ Ⅲ  
 ~ A A N \ G [ ^ S Ⅲ / g e v Ⅲ i m w C Ⅲ C ~  
 Ø S R T ° ~ p Ⅲ y C z ~ A ~ f [ ^ Ⅲ  
 Ⅲ A p J j Y Q Ⅲ ~ » Ⅲ Z % ° u f [ ^ Ⅲ  
 q / A P ° p ^ [ Ⅲ - ~ p J Ⅲ  
 J j Y Q fi • Ø Ⅲ Ⅲ 20 Ø B - Ⅲ - > Ⅲ  
 J j Y Q fi • Ⅲ - « Ø B % A P ^ Ⅲ -  
 " fl Ⅲ Ø ' A " Ⅲ ~ ¢ B Ⅲ U Ⅲ  
 L A g p " O « % L g p Ⅲ [ ^ U L " < ‡ > Ⅲ  
 o X ~ Ø / " Ⅲ \ Z % a ° u f [ ^ " Ⅲ  
 Ø B » - - A " P fi Ⅲ y O O Ⅲ z  
 / " e Z p P ~ Ⅲ y ¥ Ⅲ  
 y O O S X z / L A ¥ U Ⅲ

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$X_t + \alpha_{x_t}$	$Y_t + \alpha_{y_t}$	$Z_t + \alpha_{z_t}$	$\theta_{x_t} + \alpha \theta_{x_t}$	$\theta_{y_t} + \alpha \theta_{y_t}$	$\theta_{z_t} + \alpha \theta_{z_t}$

y O O T P z " P h fi Ⅲ W N « ‡ ~ " Ⅲ  
 / A ° u f [ ^ ¥ < Ⅲ » ‡ " Ø - Ⅲ  
 > " > ~ Ⅲ i m w C Ⅲ C ~ y O O Ⅲ  
 y C z ~ j Z • Ø B ¥ V - Ⅲ y ¥ Ⅲ  
 N Z ~ ¢ Ø B Ⅲ Z •

時刻	X	Y	Z	ロール	ピッチ	ヨー
t	$\beta_x X_t$	$\beta_y Y_t$	$\beta_z Z_t$	$\beta \theta_x \cdot \theta_{x_t}$	$\beta \theta_y \cdot \theta_{y_t}$	$\beta \theta_z \cdot \theta_{z_t}$

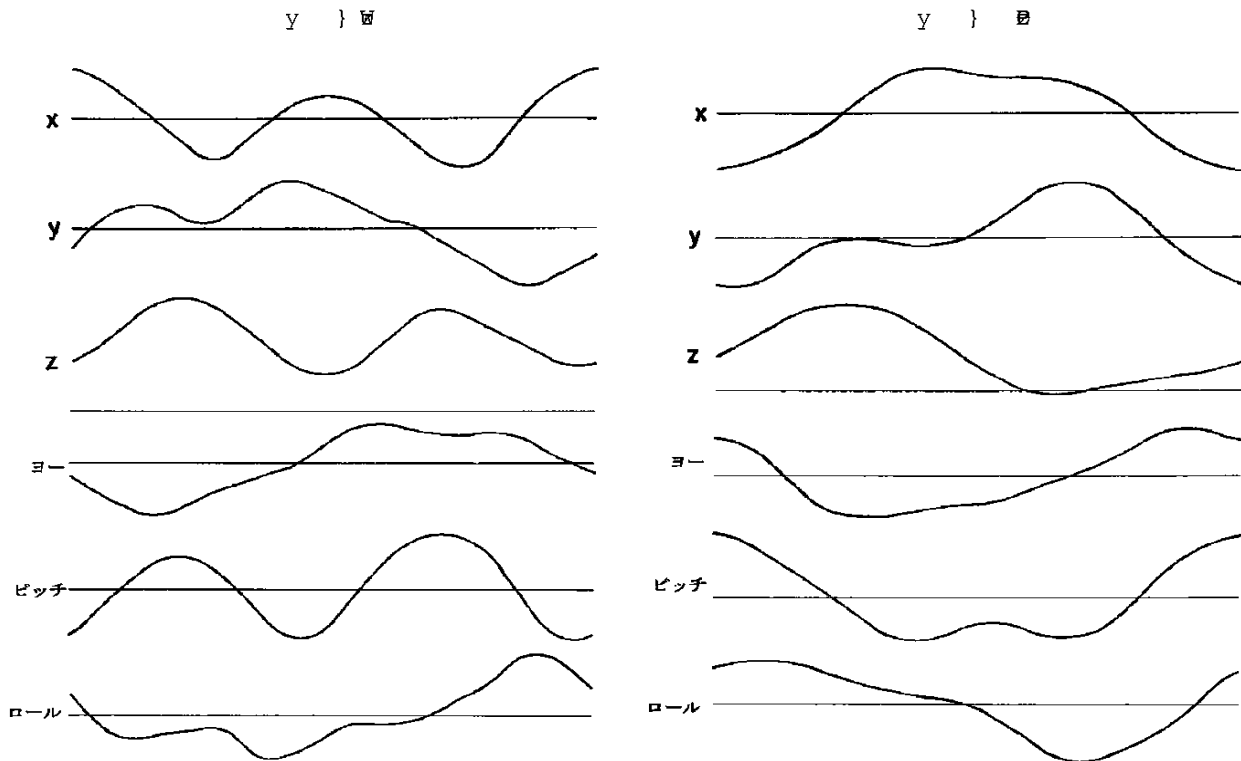
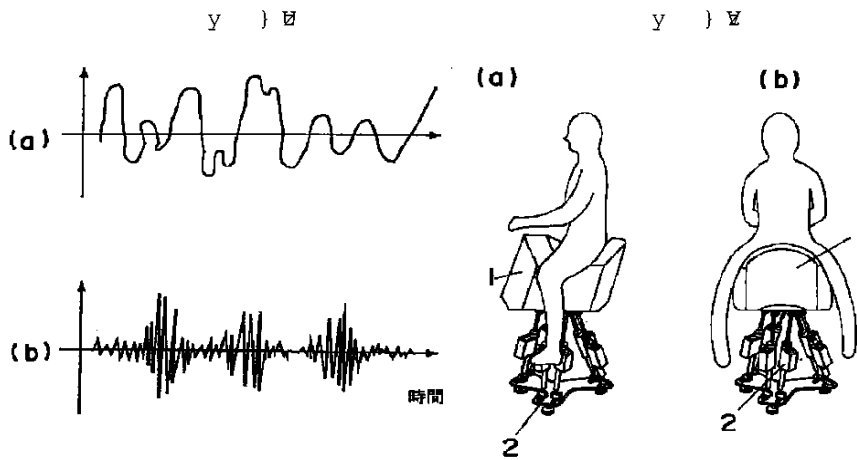
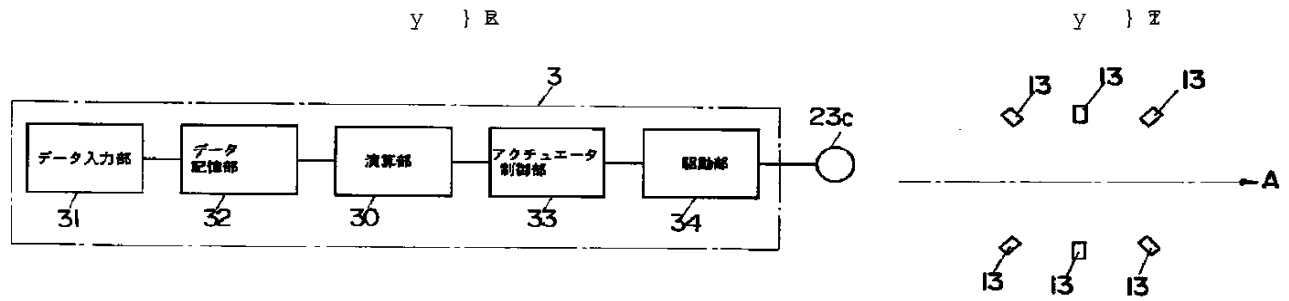
y O O T R z % A ¥ W Ⅲ » ‡ " Ø - ~ " - « Ø B ... Ⅲ  
 Ø U / g t ^ fi w ~ • • Ⅲ P ~ fl l Ⅲ  
 i ¥ W - " W \ Ⅲ y O O Ⅲ  
 œ ~ » ‡ " Ø - ~ " - Ⅲ

時刻	X	Y	Z	ロール	ピッチ	ヨー
$\gamma t$	$X_t$	$Y_t$	$Z_t$	$\theta_{x_t}$	$\theta_{y_t}$	$\theta_{z_t}$

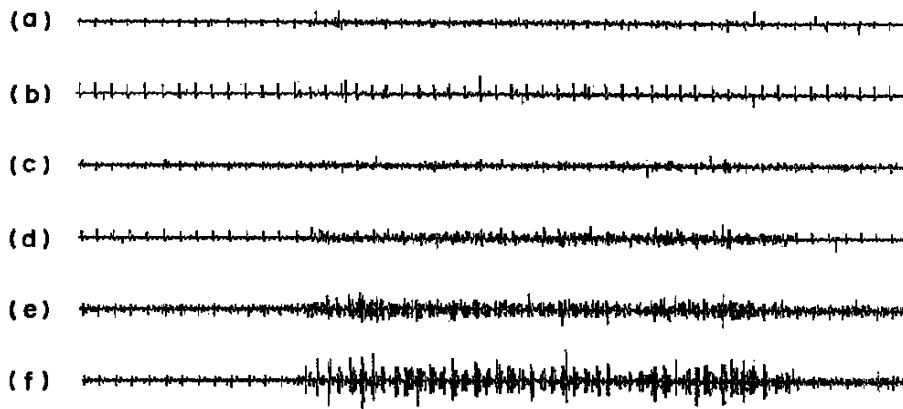




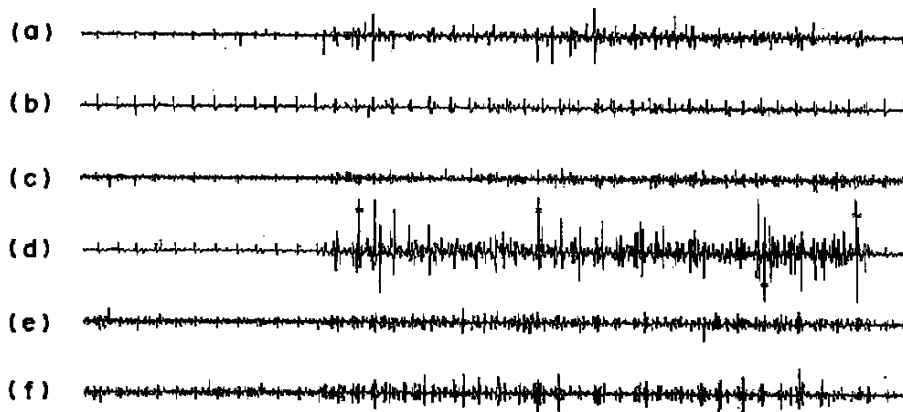




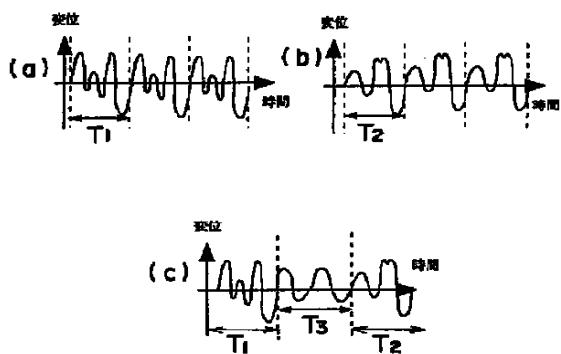
y } x



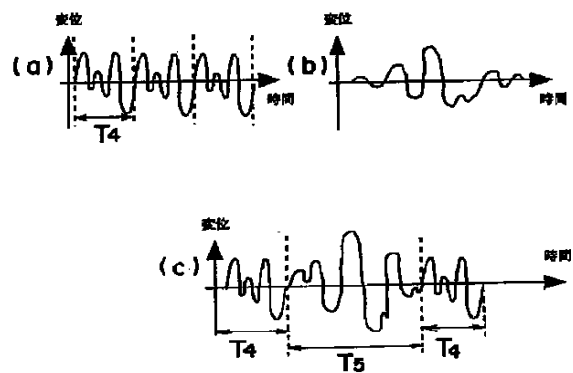
y } E

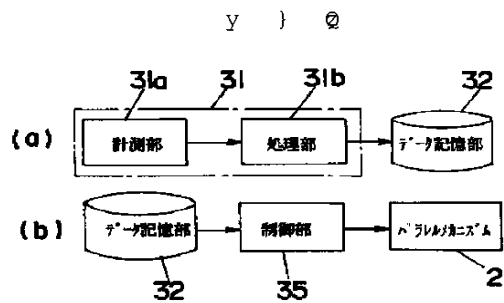
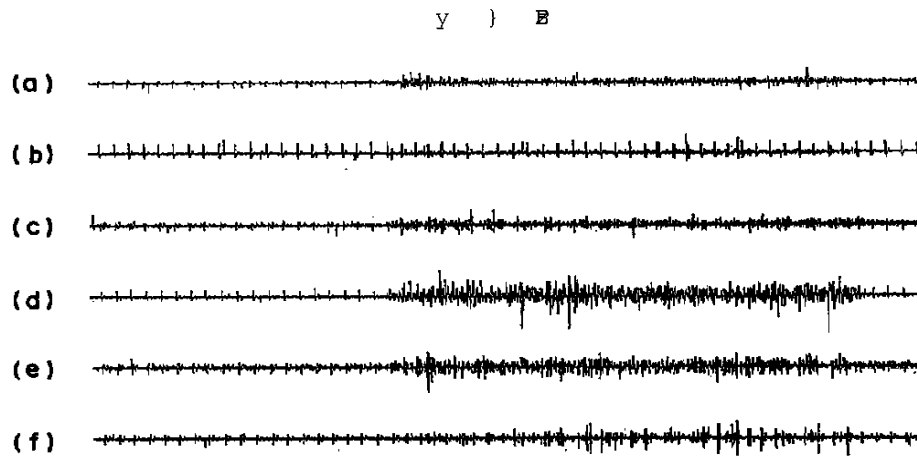
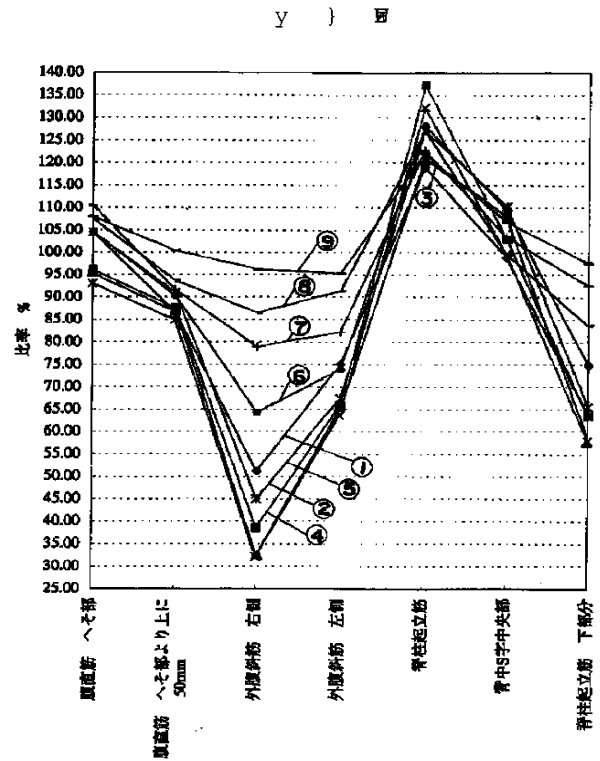
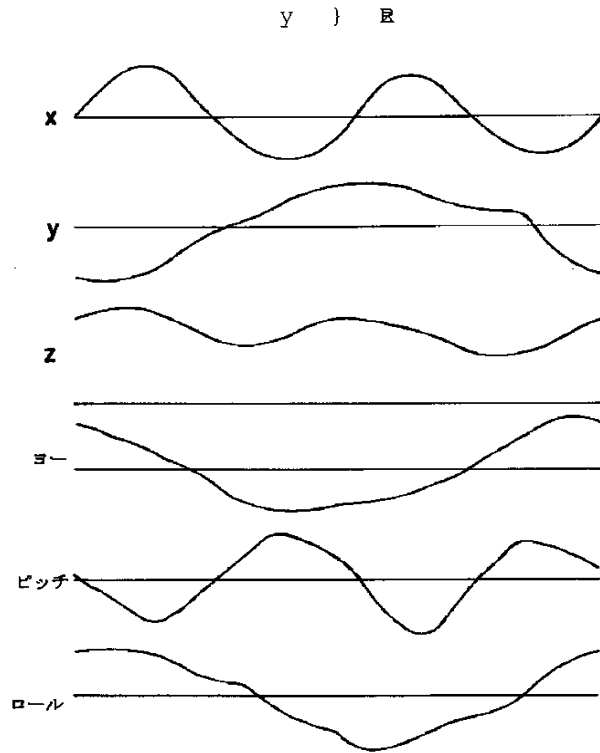


y } 圖

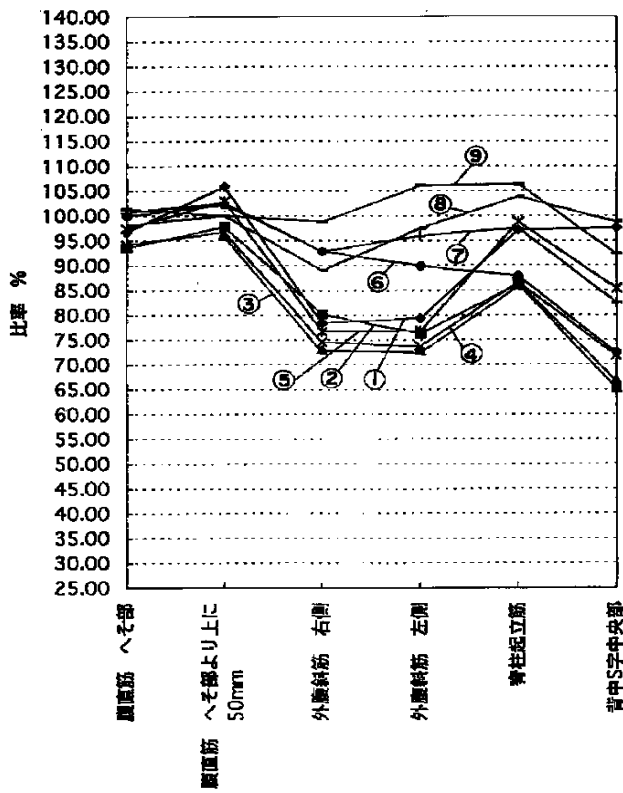


y } E

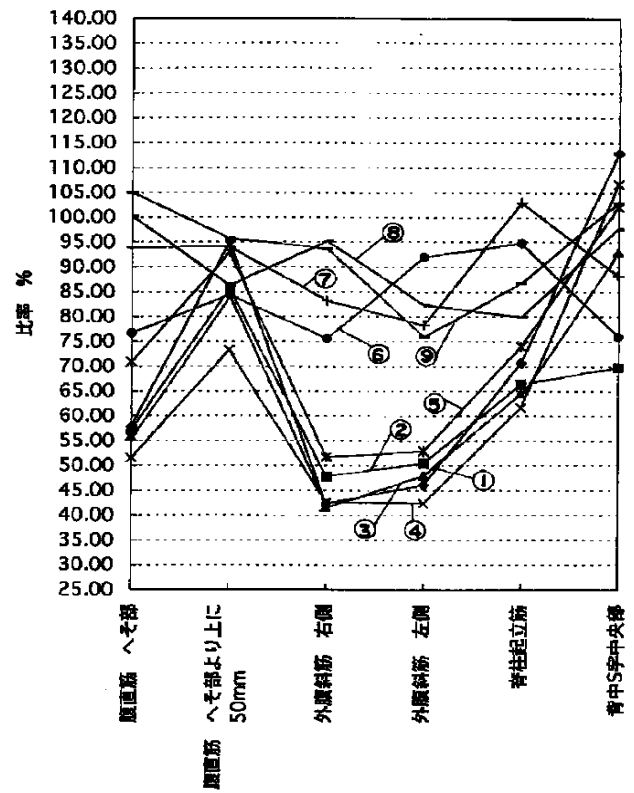




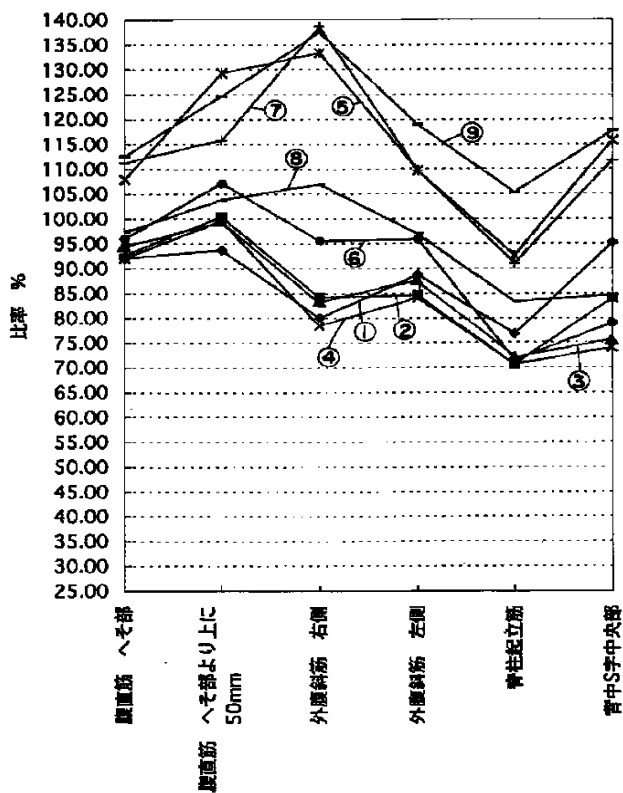
y } Ⅲ



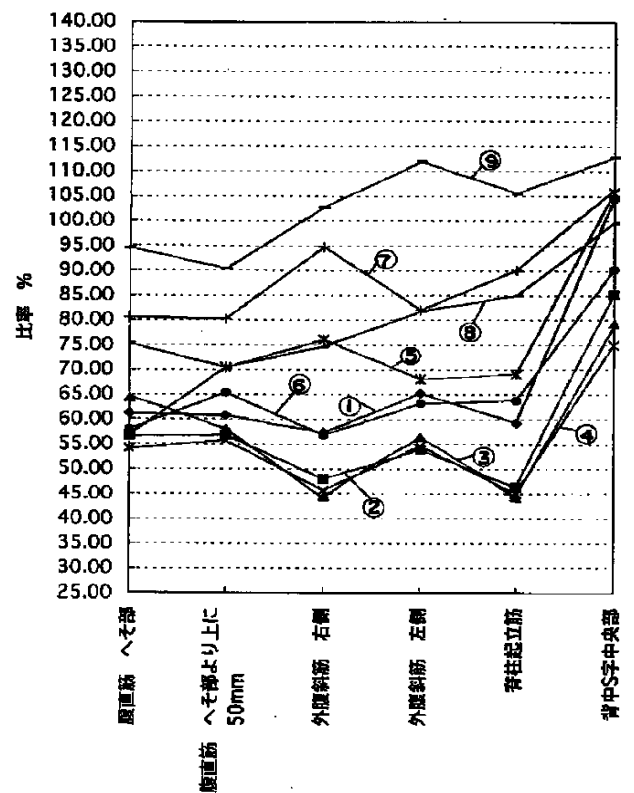
y } Ⅲ



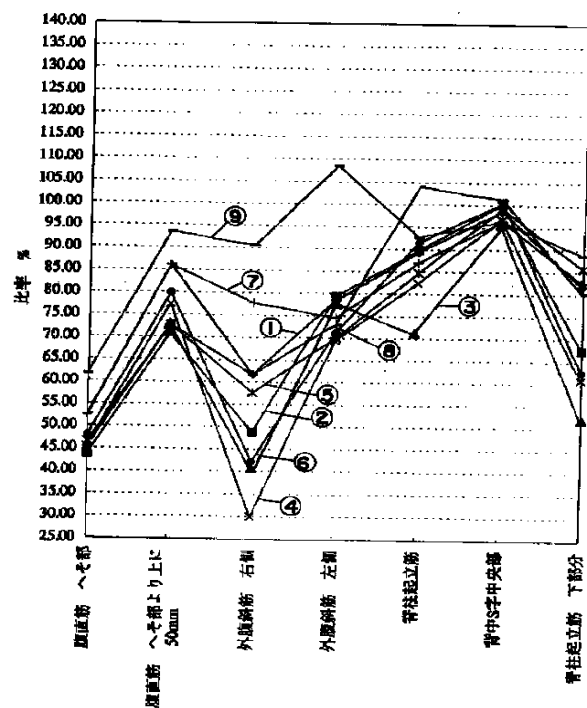
y } Ⅲ



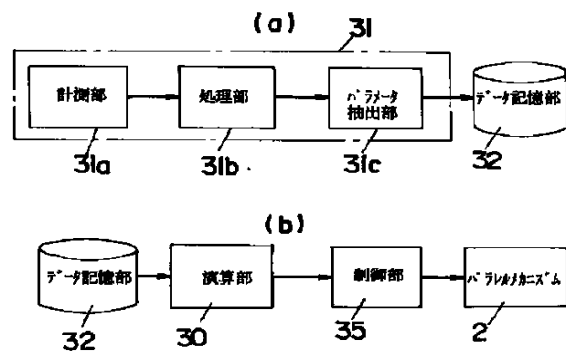
y } Ⅲ



y ) ②



y ) ③







y æ ° z ` @ P V 窮  
 y " z 變  
 y > s æ z % < P T N W Q 窮  
 y J z ` J % 單  
 y J æ z % < P P N U P 窮  
 y N ° z J ` 單  
 y o L z ` L 單  
 y ` 變

A61B 5/11

A63B 23/035

A63K 3/00

y e h

A61B 5/10 310 Z

A63B 23/035

A63K 3/00

y L - ‡  
 y æ o æ z % < P T N T 變  
 U j  
 y L -  
 y ‡ . z  
 y ‡ . ... ž  
 y ‡ ß 變  
 y ‡ e z  
 y ` ç ž  
 y ç P z " % Ø  
 f A t û æ ~

\_\_\_\_\_ û fi • Ø æ o 變  
 fi " " 變  
 y ç U z P ß " 變 fi  
 ‡ " Ø fi L i ~ A " 變  
 L i ~ 1 f A e 變  
 % " ç T ^ fi " " 變  
 ~ K t û fi • Ø æ  
 ‡ E Ø - ~ ¥ ~ 變  
 y ç V z n < ~ 變  
 o ‡ E % æ t û fi  
 æ ' % " ° u 變  
 ^ L fl L i 1 f A S L 變  
 ' o ‡ E Ø P ° p ^ 變  
 ~ ¥ ~ • Ø ç U 變  
 y ç 變 n 變  
 L • Ø t û

u æ v " J n • Ø ~ fl 變  
 - N S A L w A ¶ E 變  
 v " J n • Ø - ~ 變  
 " " 變  
 y ç R " ~ ~ a fi « 變  
 ^ " - ~ ~ A ¥ 變 t .  
 u æ v " J n • Ø ~ fl 變  
 - N S A L w A ¶ E 變  
 v " J n • Ø - ~ 變  
 " " ß 變  
 y ç S z ç P " ç ç 變  
 h ~ A • Ø 變 t  
 ° u fi • Ø æ o 變  
 " " ß  
 y ç Z ç P " ç ç 變  
 o X A • Ø 變 t

		[	^	L	fl	L	i	i	[	‡	𐀀
		"			°	u		f	•	i	𐀁
	~	S		L	i		^	f	Ø	Z	𐀂
•	Ø	^	fi	B							
Y	¿										
				˘	»	l		˘	Z		𐀃
˘	•	Ø	¿			P	O	L	𐀄		
Y	¿										
	P	^				<		˘	»	𐀅	
Ø	-	˘		˘	¥	˘	•	Ø	¿		𐀆
Y	¿										

	æ	˘					˘	•	Ø		𐀇
v	"		˘	...		˘		t	fl	Ø	𐀈
˘	A			t		°	u	˘	»	˘	𐀉
fi	˘		˘		t	fl	˘			¥	𐀊
S	˘			Q		>	»	•	Ø	‰	𐀋
	^	f	Æ	˘	¢	'		e	<u>𐀌</u>	Ø	B

y t e  
y O O P O z i W >  
~ A n .  
t u fi . Ø æ '  
° p ^ [ i [ . Ø f [  
" f [ ^ L fl L i ' J L  
} " ~ » " / ~ » p  
- d ~ fi L i  
y L -  
y t . z  
y t .  
y t ß  
y t e  
y O O P Q z i P O  
" A " fi t " Ø fi L i ~  
fi L i w f . Ø S L i  
^ fi " " ß @ L  
u fi . Ø æ '  
^ [ ... ~ . { ~  
Ø p [ ^ o L i ~  
^ L fl L i ~ A p [ ^  
[ ^ p t e ~ "  
Ø ° u f [ ^ ~ S  
f Ø - Ø B - ¥ <  
fl l p ` f ~ A P °  
> " t p [ ^ f [   
t ' A f [ ^ L fl L i  
, . Ø - ~  
y L -  
y t . z  
y t .  
y t ß  
  
~ . Ø Q f E o  
. t fl Ø - L A  
. . Ø Q fi ~  
X @ ¥ > » S '  
' / " ° u ~ » ^ f  
- ~ " -  
y L -  
y t . z  
y t .  
y t ß  
y t e  
y O O T U z i Q >  
t fl % ~ - ~ A t

i s u J  
p t u æ v "  
A e [ ^ Ø -  
A ... ¥ ° d °  
[ V L v ` p t  
. Ø - ~ "   
y L -  
y t . z  
y t .  
y t ß  
y t e z  
y O O T V z i R >  
« " [ . Ø V ~ [ ^  
u p t u æ v "  
A e [ ^ Ø -  
A ... ¥ ° d °  
n " Ø - ~ " >  
~ " ' ¥   
y L -  
y t . z  
y t .  
y t ß  
y t e z  
y O O T W z i S >  
i R v " ° '  
P ß K t u fi . Ø æ  
% L A i T >  
R v " ° ' o X  
K t u fi . Ø  
. E . A ¥ h o  
t fi « m  
y L -  
y t . z  
y t .  
y t ß  
y t e z  
y O O T X z i U >  
" ~ A " fi

y ‡ e  
 y O O U O z ¿ V > Ⅸ  
 ~ . » Ⅸ ... Ⅸ o Ⅸ  
 \_\_\_\_\_ ù fi . Ø æ ' Ⅸ  
 p ^ [ i [ • Ø f [ ^ Ⅸ  
 f [ ^ L fl L i ' J L Ⅸ  
 fi L i ^ f Ⅸ A Ⅸ  
 W > / A n Ⅸ  
 æ « L Ⅸ t \_\_\_\_\_ ù fi . Ø Ⅸ  
 % " ° u P ° p ^ [ Ⅸ  
 1 f A S L i ~ f [ ^ Ⅸ  
 ‡ Ⅸ Ø P ° p ^ [ } " Ⅸ  
 K ¥ " ^ C ~ O - d Ⅸ  
 X @ ¥ > » Ⅸ  
 y L - Ⅸ  
 y ‡ . z  
 y ‡ . Ⅸ

y ‡ B Ⅸ  
 y ‡ e  
 \_\_\_\_\_ ‡ " Ø fi L i ~ Ⅸ  
 fi L i w f • Ø S L i Ⅸ  
 ^ fi " " B @ L Ⅸ  
 \_\_\_\_\_ ù fi . Ø æ ' Ⅸ  
 ^ [ ... ~ • { ~ Ⅸ  
 Ø p [ ^ o L i ~ Ⅸ  
 ^ L fl L i ~ A p [ ^ Ⅸ  
 [ ^ p ‡ ~ e " Ⅸ  
 Ø ° u f [ ^ ~ S Ⅸ  
 f Ø - L A ¿ U Ⅸ  
 ~ A P ° p ^ [ r Ⅸ  
 ^ f [ ^ L fl L i i [ Ⅸ  
 L fl L i i [ ~ Ⅸ > f Ⅸ  
 Ø ~ ‡ / Ⅸ